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WOOD USE BY ALABAMA MINES

By

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For every ton of coal they produce, the larger underground coal mines in the territory of the Birmingham Branch of the Southern Forest Experiment Station use more than three-fourths of a cubic foot of wood. Underground iron ore mines in the same area use one-fourth of a cubic foot per ton of output. In 1945, these coal and ore mines used about one-fifth of the 80 million cubic feet of timber products harvested in the Birmingham territory.^{1/}

Wood is needed in all underground mining operations in this territory. It supports the roof of the seam. It is used to build cars for transporting coal and ore, and it carries the rails for these cars. It is made into partitions for controlling ventilating air currents. It goes into necessary above-ground structures. For these and many other uses, wood has no economical substitute.

The great quantity and wide variety of the wood needs of these mines form a large and diversified market for forest products. Forest owners in few other territories of the South have such good markets for wood of small size, inferior species, and low quality--in addition to the usual markets for better timber. As a result, the Birmingham territory has unusually favorable conditions for good forest management and utilization.

On the other hand, if wise use is not made of them, the heavy and diversified demands for mine wood create a real forest problem. Props, for example, can be cut from clear young pines that have barely entered the period of most valuable growth--just as easily or even more easily than from rough hardwoods of little value for anything else. Thus good markets and excellent opportunities for utilization may lead to forest deterioration, and have done so in north central Alabama.

Realizing that mine-wood consumption is a key to the opportunities and problems of forest conservation in north central Alabama, the

^{1/} The Birmingham territory includes 7-1/2 million acres of north central Alabama. This area accounts for 23 percent of the forest land, 19 percent of the timber output, and essentially all of the coal and iron ore output of the State. Boundaries are shown in Figure 1.

Birmingham Branch of the Southern Forest Experiment Station in 1946 made a survey of the quantity and kinds of wood products used in the mines. Records were obtained from a sample of 108 underground coal mines and 10 underground ore mines. These sample mines accounted for most of the coal and iron ore produced from underground mines in the Birmingham territory in 1945. At the same time that the survey was made, preliminary and partial consideration was given to two questions: What is the effect of mine use on the forests? How can this use be changed so as to improve forest conditions?

Amount and Value of Wood Used

Wood products used in the underground coal and ore mines in 1945 totaled $15\frac{1}{2}$ million cubic feet. This figure was obtained by multiplying tonnage output from each type of mine by the rates of use. The results are elaborated in Table 1. These wood products were worth \$3,472,000 delivered at the mines.

The geography of underground coal production (17.7 million tons in 1945) and the principal area of mine-wood cutting activity are shown in Figure 1. Not indicated on this map are the 6.3 million tons of underground ore production, all from Jefferson County, in which Birmingham is located.

Table 1.—Quantity of wood products used in underground mines in the Birmingham territory, 1945

Class of mine	Props	Ties and timbers	Lumber	Capboards and wedges	All products
- - - - - <u>Thousand cubic feet</u> - - - - -					
Coal mines with railroad connections	6,675	2,453	2,597	1,227	12,952
Coal mines without railroad connections	728	51	44	53	876
All coal mines	7,403	2,504	2,641	1,280	13,828
Ore mines	321	1,140	208	3	1,672
All mines	7,724	3,644	2,849	1,283	15,500

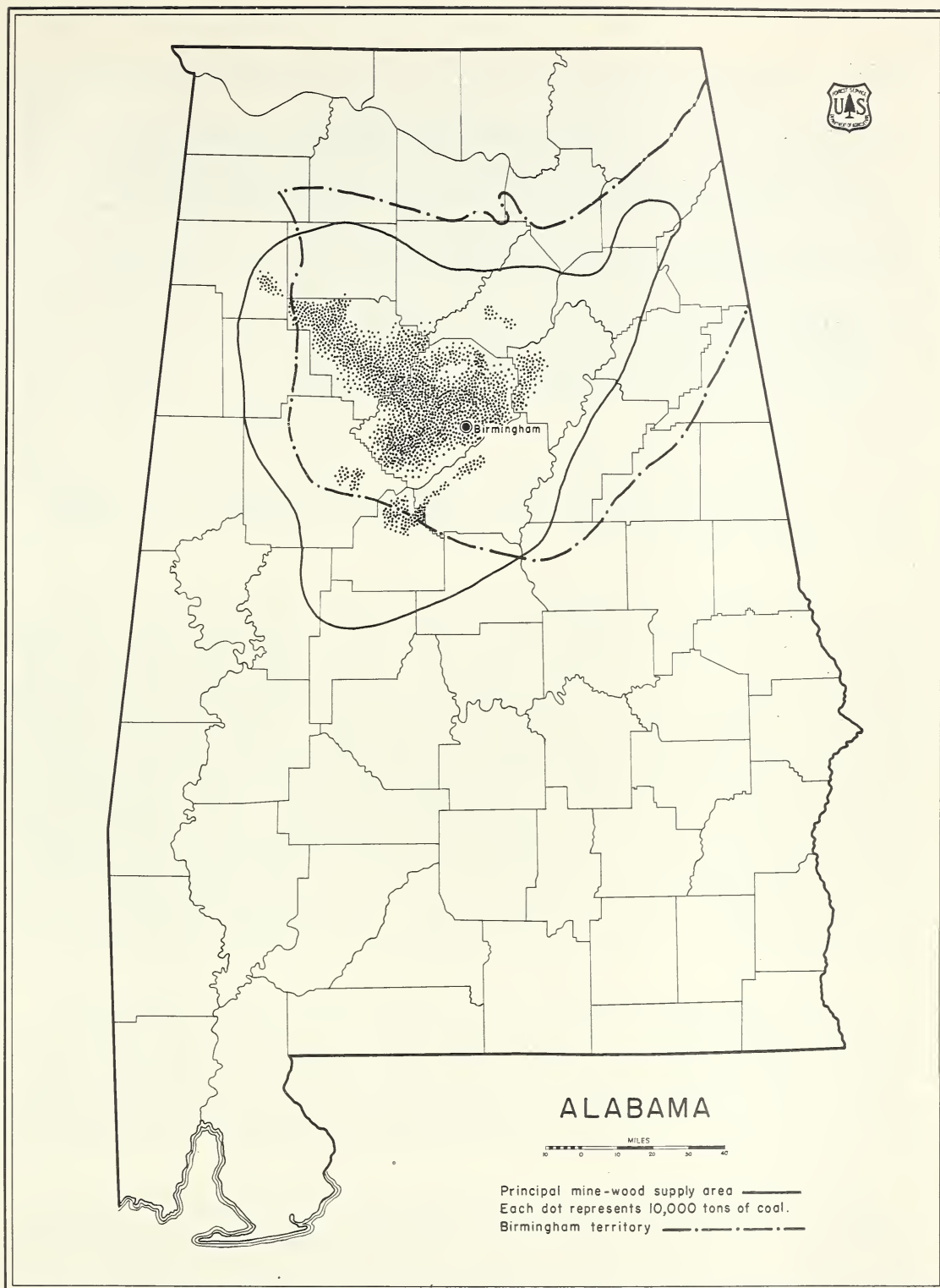


Figure 1.--Coal production from underground mines and principal mine-wood supply area for the Birmingham territory, 1945.

Table 2.--Rate of wood use by underground mines in the Birmingham territory, 1945

Class of mine	Props	Ties and timbers	Lumber	Capboards and wedges	All products
	- -	Cubic foot per ton of output			- - -
Coal mines with railroad connections	0.419	0.154	0.163	0.077	0.813
Coal mines without railroad connections	.414	.029	.025	.030	.498
Ore mines	.051	.181	.033	.005	.270

In their use of wood, coal mines fall into two distinct classes: (1) mines with railroad connections, most of them producing at least 50,000 tons of coal annually; and (2) mines without railroad connections, mostly smaller mines.

Coal mines with railroad connections used 0.813 cubic foot of wood per ton of output (Table 2).^{2/} The 79 mines in this class produced 90 percent of the coal mined in the area. Most of them are owned and operated by iron and steel companies. Thus they are part of a large and heavily capitalized business in which mechanization and other operating improvements are carried the furthest. This makes for heavy use of wood. Well-laid and extensive coal- and ore-car trackage and well-built structures require many cross ties and timbers for both construction and maintenance. Company dwellings and other elaborate surface structures as well as heavy use of brattice (partitions in the underground passageways to guide the flow of ventilating air) consume much lumber. Capboards and wedges too are used more extensively by the larger mines. Only for props (round or split wooden uprights used to support the weight of the mine roof) is the rate of consumption about the same as in the smaller coal mines.

The coal mines without railroad connections used 0.498 cubic foot of wood per ton of output--about six-tenths the rate of mines with railroad connections. Many of these smaller mines are owned by individuals or small companies. Generally speaking, such mines work narrow seams of coal and use simple equipment and intensive hand methods of operation. Mules are used to pull the mine cars; the larger

^{2/} Here and subsequently, these are cubic feet of wood in finished products as delivered to the mines. They are not cubic feet of standing timber. On the average, roughly 1-1/3 cubic feet of standing timber are required to produce one cubic foot of finished products. The exact relation was not, however, determined in this study.

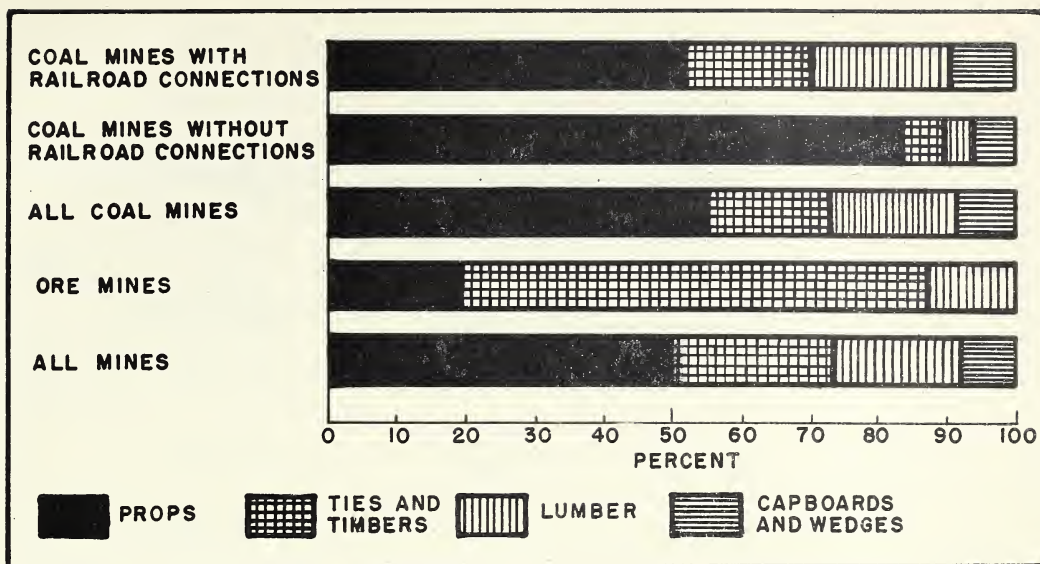


Figure 2.--Percentage use of the different types of mine wood (based on cubic-foot volume) by each class of underground mine in the Birmingham territory, 1945.

mines use electrical equipment for this purpose. Smaller mine cars and less elaborate underground structures permit a relatively light use of ties and timbers. The rate per ton of coal is less than one-fifth of that in the railroad mines. Again the rate of lumber consumption is less than one-sixth of that in the larger mines, as there is little construction of company houses and other surface buildings and relatively sparing use of ventilating partitions. The rate of consumption of capboards and wedges is about four-tenths of that in the mines with railroad connections.

The 12 underground ore mines in the Birmingham territory used an average of 0.270 cubic foot of wood per ton of output. These are all large mines operating in thick seams with the aid of heavy underground structures. Their rate of consumption of ties and timbers is the highest of any of the types of mines. However, they make relatively light use of other products.

Figure 2 shows how the different types of mines use the wood they buy. Of the total wood consumed in the Birmingham mines in 1945, the following percentages were used by each class of mine:

Coal mines with railroad connections	83%
Coal mines without railroad connections	6%
Ore mines	11%.

Props accounted for about 1-1/3 million dollars, or 38 percent, of the 3½ million dollars' worth of mine wood used in 1945. Ties and timbers were worth 1-1/5 million dollars, or 35 percent of the total. The other products had smaller values (Table 3).

Table 3.—Value of wood products delivered to mines in the Birmingham territory, 1945

Type of product	Average price per cubic foot	Total value
	<u>Cents</u>	<u>Dollars</u>
Props	17.0	1,313,000
Ties	{ 26.9 }	1,199,000
Timbers		
Lumber	26.9	767,000
Capboards and wedges	15.0	193,000
All products	22.4	3,472,000

The average delivered price of all wood products was 22.4 cents per cubic foot in 1945. This is about three times the 1941 average price. In 1945, the cost of wood amounted to 4.3 percent of the total cost of producing coal and ore, a higher percentage than in previous years.

Types of Wood Products Used

The various wood products used by the mines fall into four types: (1) props, (2) ties and timbers, (3) lumber, and (4) capboards and wedges. These types differ greatly in their specifications and use and in the effect which harvesting them has upon the forest.

Props

Props vary in length according to the thickness of the seam in which they are used. The principal coal seams require props from 18 inches up to 6 to 8 feet long. Ore seams call for longer props, usually from 12 to 16 feet.

About 7-3/4 million cubic feet of props were used in 1945. This is about half of the volume of all wood products used by underground coal and ore mines in the Birmingham territory. In 1945, 85 percent of all coal mine props made in the Birmingham area were from 3 to 6 feet long (Figure 3). Five percent were shorter than 3 feet and only 10 percent were longer than 6 feet. Though not so many long props are cut, they are very important in terms of wood use because each prop contains a large volume of wood. For example, props 12 feet long or longer take nearly one-fourth of the total amount of wood going into props used by both iron ore and coal mines. Prices for mine props are shown in Table 4.

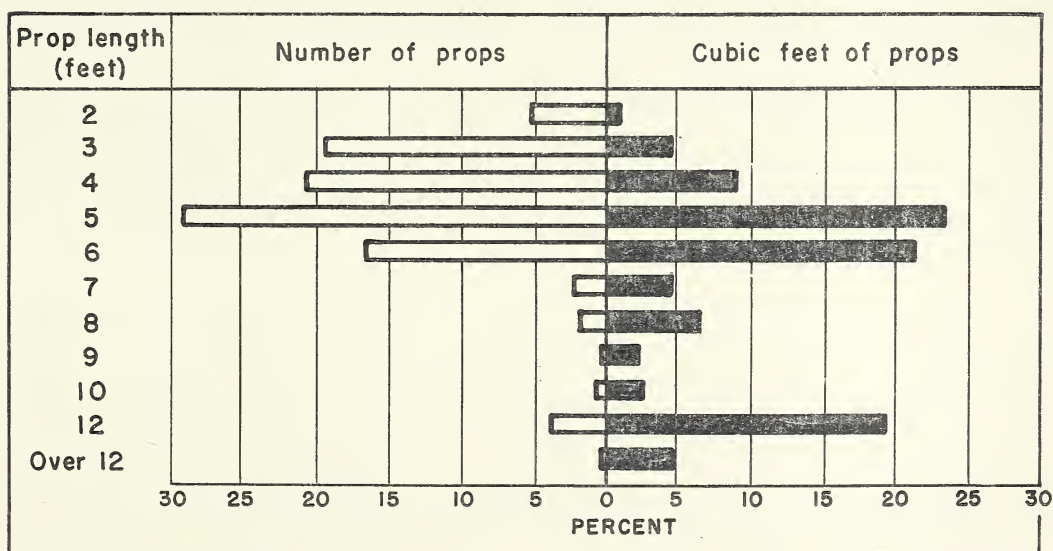


Figure 3.--Percentage distribution, by prop length, of number and cubic-foot volume of props cut in north central Alabama, 1945.

Table 4.--Average delivered price of mine props in the
Birmingham territory, 1945

Length of props (feet)	Price per prop Cents	Quantity of wood per prop Cu. ft.	Price per cubic foot Cents
2	6.0	0.19	31.6
3	7.0	.26	26.9
4	8.5	.38	22.3
5	15.5	.79	19.6
6	22.0	1.34	16.4
7	26	2.15	12.1
8	37	3.15	11.7
9	40	3.55	11.3
10	44	3.94	11.2
12	55	7.21	7.6
Over 12	70	9.24	7.6

In general, the diameter of props at the small end in inches is about equal to the length in feet. However, the minimum diameter, except for long props, is usually 4 inches and the maximum 8 inches. Long ore props are commonly 10 inches in top diameter. Props must be reasonably sound and straight. Straightness is more important in the longer props than in short ones. Sound knots are no defect, but limby timber is generally avoided by the cutters. Bark is left on except when props are given preservative treatment for use in main haulage-ways. However, as props are not expected to last long, comparatively few are treated.

Southern pine has always been favored for mine props. The pines, with their straight, clear stems and generally softer wood, are easier than hardwood to saw, limb, and split. Furthermore, there has been a widespread belief that pine props are safer than hardwood because they give warning prior to a fall by making a noise and by splintering (brooming) at the top.

In recent years, however, more and more hardwood has been used for props. Today it is estimated that between one-fourth and one-third of the total volume of props is hardwood. This change has come about primarily because the supply of pine timber has been depleted. One of the largest coal producers has begun to put much inferior hardwood timber into props, and other companies are taking some hardwood along with pine. This is certainly a proper trend, for mines in other regions of the country have had a long and successful experience with hardwood

props. Unquestionably, the mines of the Birmingham territory should, with full confidence, continue to increase their use of hardwood for props. Improvements in harvesting and milling practices and equipment will also encourage the use of more hardwood in the mines by reducing the cost of harvesting and manufacturing.

Certainly prop utilization is of key importance in forest management in the Birmingham territory, where the forests badly need stand improvement cuttings. Provided it meets the size requirements, almost any inferior tree, hardwood or pine, can be made into props. And the variety of lengths in which props are needed offers opportunity for full utilization of trees.

Ties and timbers

Ties and timbers took 23 percent of the total amount of mine wood cut in 1945. Ties are used to support the coal- and ore-car rails both above and below ground. Timbers are herein defined as any sawn product--other than ties--more than $3\frac{1}{2}$ inches thick.

Tie sizes range from 7- by 9-inch standard gage ($8\frac{1}{2}$ feet long) down to small ties 4 x 5 inches in cross section and $4\frac{1}{2}$ feet long. A few of the larger mines and most of the smaller mines use ties faced on two sides only. Very small ties used in some of the small mines are hewn from 3-inch poles. Even less hardwood is used for ties than for props--an estimated 20 percent of all tie material. One reason for this is the increasing use of preservative treatment, to which pine is better adapted in the processes now followed. Most hardwoods are used untreated, and oak and gum are the preferred species. Like props, ties may be cut from inferior timber. Knots are no defect and crook in one dimension is permitted. Freedom from rot is the principal requirement.

Timbers vary in size even more than ties do. The most common sizes, 4 x 6 or 6 x 8 inches in cross section and 12 feet long, are used extensively in the coal mines as cross collars. These collars, placed under the roof and held at each end by props, furnish extra support along main haulageways and carry electric wiring.

In the ore mines heavy timbers 8 to 12 inches square and 8 to 30 feet long are used for roof support. Timbers are also used in tip-ple, washers, and other surface structures. The specifications for these longer, larger timbers are comparatively exacting. The timbers must not only be strong but also durable, for they are used in more permanent installations. In general, the large timbers require the best trees that can be found in the Birmingham area. Suitable trees are becoming very scarce.

Lumber

Nineteen percent of the mine wood used in 1945 went into lumber. Lumber can be defined as all sawn material up to $3\frac{1}{2}$ inches in thickness. It is used for construction and maintenance around the mines, for making coal and ore cars, and for various purposes within the mines. Its principal use within the mines is as brattice.

Mine lumber offers wide possibilities for good utilization of trees. Brattice lumber and much of the other lumber used is 1 inch thick. Demand is good for short lengths down to 6 feet. The lowest grades of rough lumber are suited to the great bulk of underground use, and hardwood is just as satisfactory as pine. For above-ground structures, pine is used the most. Number 2 Common or better grade is usually demanded. For car stock, 3-inch sound hardwood planks are needed. Together with ties and shorter timbers, mine lumber is a promising field for increased use of the low-grade hardwoods which now occupy much forest land in the mining region.

Capboards and wedges

Eight percent of the 1945 cut of mine wood went into capboards and wedges. They are used to make a tight fit between vertical timbers and other members of the structure. If a prop is 2 inches too short to meet a roof timber, workers will put a capboard on top of the prop to take up the space and then drive in a wedge to make a tight fit. In this way, the use of capboards and wedges makes it unnecessary to saw timbers to the exact length needed for particular jobs. This permits the use of standard length material. Capboards also furnish more of a bearing surface for the roof. They are generally $1\frac{1}{2}$ inches thick and vary from 6 x 12 inches to 8 x 16 inches in width and length, the larger size being the most common.

Wedges are used in both coal and ore mines. More wedges are used than capboards. The common size is 6 x 12 inches, with a thickness of 1 inch at the butt end. Wedges are sawed on a special machine that resembles a shingle mill.

Both capboards and wedges may be cut from material of the poorest quality. Capboards are commonly made from slabs and pieces of cull boards. Hardwood and pine are used indiscriminately. Capboards and wedges carry to the furthest degree the close utilization possible in the production of mine material.

Wood Procurement Methods Affect Utilization

By long-standing custom, each mining company gets its wood through its own special contractors. Quite often the contractor cuts only one product or size at a time. As a result, utilization is generally wasteful. If the contractor's orders included a complete range of products and sizes, much material that is now left in the woods could be made into short props, capboards and wedges, and the like. Furthermore, much of the wood that is taken is not put to the most advantageous use.

The need is apparent for the pooling of requirements both within and among companies. One or two operators are already moving in this direction--letting contracts covering some of the varied needs of groups of mines, selling their high-quality logs for more exacting uses, and thus achieving better utilization of their timber.

Effect of Mine Use on the Forest

The whole story of mine use cannot be told or understood except by reference to the forest from which the wood comes. Of course, present forest conditions are not due entirely to mine use, but they have been strongly influenced by it. Figure 1 shows the area from which most of the mine wood comes.

Of the 4-1/3 million acres of forest land in the Birmingham territory, the stand on 2.8 million acres (65 percent) is considered depleted. Of these depleted lands, 1.2 million acres show moderate to heavy depletion. They are stocked with only one-half to three-fourths of the trees of desirable species and quality which they could be expected to grow. Another 1.2 million acres are more seriously depleted, with a stocking of only one-fourth to one-half. Finally, an additional 0.4 million acres show extreme depletion, with less than one-fourth stocking.^{2/}

The preference for pine, not only by the mines but also by other lumber users and pulp mills, means that pines are being cut out of the forests and hardwoods left to grow. As a result, hardwoods are taking more of the growing space every year. In the decade preceding 1946, the total pine growing stock^{4/} dropped 18 percent while hardwood growing

^{3/} In terms of basal area of desirable trees 3.6 inches d.b.h. and larger, the three depletion classes are defined as follows: (1) moderate to heavy, 51 to 75 square feet per acre; (2) serious, 26 to 50 square feet; (3) extreme, 25 or less.

^{4/} In sound trees 5 inches and larger in diameter at breast height.

stock increased 11 percent. Most of this increase was in small trees of inferior species such as hickory, black gum, and undesirable oaks.^{5/} In the same 10 years, the total sawlog growing stock of all species declined by 40 percent.

Pine saw-timber trees, although rather scarce, are still being cut and split for props. Furthermore, small straight pines capable of developing into sawlog trees are also being harvested for props. The result is that pine sawlog timber and potential sawlog timber is being put to a use which could just as well be served by low-grade cull trees now being left in the stand. Because of this practice the forest is constantly being depleted as low-grade and cull trees seize proportionately more of the growing space.

Depletion, though widespread, has not been uniform over the entire forest area. The most accessible lands have been used the hardest. Many tracts convenient to the mines have been relied on so heavily that they now have few trees larger than 5 inches in diameter. In general, too, the most accessible forests have been burned most frequently, a factor that has contributed much to depletion.

There is no easy solution to north central Alabama's forest problem. But the first step is to use more low-quality timber, especially hardwoods, for props, ties and timbers, and lumber. This step would let the remaining stand grow better, and would also make room for more good trees to come in. Mine owners would be among the first to benefit from such improved forests, since they own much of the land from which they draw their wood.

^{5/} In pines 9 inches and larger, hardwoods 13 inches and larger, in diameter at breast height.